



Real World Globes

18 Inch Globe Kit

Lesson Activities & Curriculum Standards

#1 Hemispheres & Wedges

Students will be using circular and spherical terms such as radius, diameter, circumference, great circle, partial spherical wedge, spherical wedge and hemisphere. They will be finding the measurements, area or volume of these terms.

#2 Spheres & Rectangular Solids

Students will measure angles and lengths of a partial spherical wedge. They will use these measurements to determine the surface area and volume of a sphere. Students will apply this information into rectangular solids.

#3 Design a Home using Domes & Hemispheres

Students will visualize relationships between two-dimensional and three-dimensional objects. They will apply geometric concepts in modeling situations. Students will use a real-life and mathematical problem involving angle measure, length, area, and surface area.

#4 Global Navigation Concepts & Principles

Students will see the locations that Sir Francis Drake visited during his circumnavigation of the earth. They will estimate locations graphically using logical reasoning.

#5 Great Circles

Students will be using circular and spherical terms such as minor arc, major arc, great circle, and hemisphere. They will be finding the measurements and lengths of these terms. Students will visualize relationships between two-dimensional and three-dimensional objects



#6 Angles

Students will measure angles on the sphere and draw great circles with respect to the equator. Students will develop an understanding between two-dimensional and three-dimensional objects.

#7 Latitude, Longitude & Antipodes

Students will develop an understanding of latitude, longitude & antipodes. They will plot and label locations using mathematical and geographical terms.

#8 Determining Distance & Position

Students will plot and label locations using geographical terms. They will find the distance and bearing between cities.

#9 List of CA Earth Science curriculum standards which can be addressed in the classroom using the RealWorldGlobe.



Real World Globes – Spherical Math Manipulative™ Spherical Activity # One – Hemispheres & Wedges®

Purpose:

- To study and investigate the form and function of domes and hemispheres, and their components.
- Introduce principles of spherical geometry

Supplies:

- A large paper (about 36-inches). An unfolded newspaper works well
- Masking or painter's tape
- 4 triangular spherical wedges.

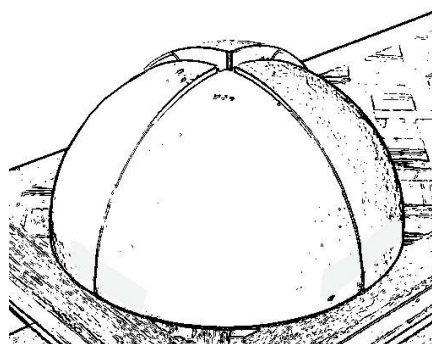
Tasks

1. Create a hemisphere from 4 spherical wedges.
2. Complete 7 math exercises based on the dimensions and characteristics of a hemisphere

Task 1: Globe Assembly

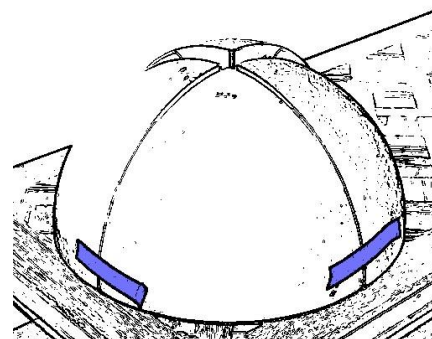
Step 1

- Prepare 8 pieces of temporary tape (4 to 6 inches, with one end pinched back).
- Put 4 spherical sections on a flat table top and arrange in a dome shape.
- It helps to have a partner to aid in holding the hemisphere together, but it is surprisingly stable.



Step 2: Line up each seam and tape the sides

- Keep the sections flat on the table and line up two of them so the seams match. It helps to hold them together at the pole with one hand and to tape the side adjacent to the tabletop with the other hand.
- If working as a team, one can hold the poles together while another applies the tape.
- Tip. If working alone, put the temp tape on one side first, then you can use the tape to hold and maneuver the pieces into place before taping.
- Tape the sides of all four seams.



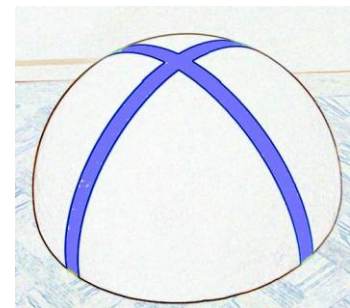
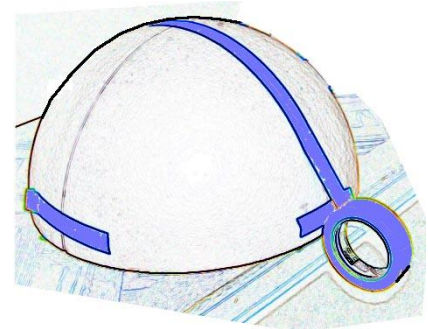
Step3: Flip hemisphere over and tape bottom edge

- After the sides have been taped the dome is stable enough to flip over so you can work on the bottoms of the seams.
- Line up the outside edges and tape in place to keep the alignment.
- Tape the bottoms of all four seams.



Step 4: Flip hemisphere back over, tape the outside seams

- With the sides and bottoms taped, the dome is quite stable. The intersections at the top of the dome can work a little, so line them up correctly and start taping the outside seams.
- Start about one inch beyond the pole and continue on into the inside of the dome. Remove the temporary tape pieces as you go.
- After the first seam the dome is stable. Tape all four seams and your hemisphere is complete.



Sample discussion points

- Discuss the characteristics of a hemisphere
- Why does it form a strong structure?
- What types of buildings incorporate domes?
- A spherical wedge has three 90° angles. This differs from a Euclidian triangle.



Task 2: Complete 7 math exercises based on the dimensions and characteristics of a hemisphere

Step 1

Once you have created your hemisphere place it on the newspaper and trace a circle around the outside of it in order to make the great circle.

Step 2

Now it's your task to find the following information:
(Note! Explain how you found the information.)

A) The diameter of the great circle or hemisphere is:

B) The radius of the great circle or hemisphere is:

C) The circumference of the great circle or hemisphere is:

D) The surface area of the hemisphere is:

E) The surface area of one of the spherical wedges is:

F) The surface area of one of the partial spherical wedges is:

G) The volume of the hemisphere is:

See Notes and reference sources on the next page

Activity created by: Charles Dichiera
For: www.realworldglobes.com

**Links:**

1. Real World Globes – <http://www.RealWorldGlobes.com>
2. Wikipedia, the free encyclopedia
 - a. Sphere - <http://en.wikipedia.org/wiki/Sphere>
 - b. Spherical cap - http://en.wikipedia.org/wiki/Spherical_cap
 - c. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - d. Dome - <http://en.wikipedia.org/wiki/Dome>

**California State Standard ---- 7th Grade
Measurements and Geometry****Students choose appropriate units of measure and use ratios to convert within and between measurement systems to solve problems:**

Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).

Construct and read drawings and models made to scale.

Use measures expressed as rates (e.g., speed, density) and measures expressed as products (e.g., person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.

Students compute the perimeter, area, and volume of common geometric objects and use the results to find measures of less common objects. They know how perimeter, area, and volume are affected by changes of scale:

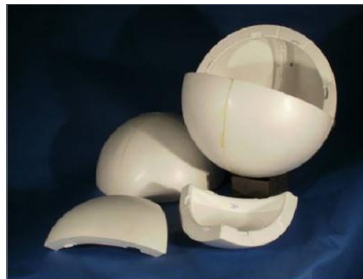
Use formulas routinely for finding the perimeter and area of basic two-dimensional figures and the surface area and volume of basic three-dimensional figures, including rectangles, parallelograms, trapezoids, squares, triangles, circles, prisms, and cylinders.

Estimate and compute the area of more complex or irregular two- and three-dimensional figures by breaking the figures down into more basic geometric objects.

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Real World Globes – Spherical Math Manipulative™ Spherical Activity # Two – Spheres & Rectangular Solids®

Purpose:

- To study and investigate the form and function of the components comprising curved surfaces and spheres.
- Introduce principles of spherical geometry

Supplies:

- 1 triangular spherical wedge
- Spherical protractor
- Tape measure

Task 1

- a) Measure the sides and angles of the triangular spherical wedge.
- b) Draw a diagram of the partial spherical wedge and label its dimensions.

Task 2

Find and derive the following information:
(Note! Explain how you found the information.)

- A) What is the sum of the angles of the triangular spherical wedge?
- B) This triangular spherical wedge is a component of a complete sphere. What is the total surface area of the complete sphere?
- C) The total volume of the sphere this triangular spherical wedge comes from is:
- D) Draw and label the dimensions of a rectangular solid that has the same surface area as the sphere.
- E) Find the volume of the rectangular solid:
- G) Which shape has the larger volume?

See Notes and reference sources on the next page

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Links:

1. Real World Globes – <http://www.realworldglobes.com>
2. Wikipedia, the free encyclopedia
 - a. Sphere - <http://en.wikipedia.org/wiki/Sphere>
 - b. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - c. Spherical packing - http://en.wikipedia.org/wiki/Sphere_packing

California State Standard ---- Geometry

Students know, derive, and solve problems involving the perimeter, circumference, area, volume, lateral area, and surface area of common geometric figures.

Students compute the volumes and surface areas of prisms, pyramids, cylinders, cones, and spheres; and students commit to memory the formulas for prisms, pyramids, and cylinders.

Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.



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Real World Globes – Spherical Math Manipulative™

Spherical Activity #3 - Design a Home using Domes & Hemispheres©

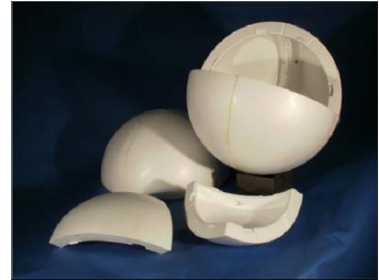


Purpose:

- To study and investigate the form and function of domes and hemispheres, and their components.
- Relate the above to architectural structures
- Introduce principles of spherical geometry

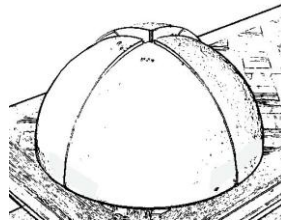
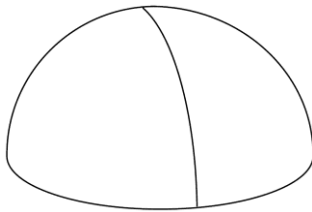
Supplies:

- 1 to 8 triangular spherical wedges.
- Masking or painter's tape
- Architectural white board, or graph paper
- XACTO knife



Tasks

1. Design a home using the triangular spherical wedges
 - The number of partial spherical wedges used is your decision



2. A physical scale model of the home will be created with a legend.
3. Draw a diagram of the home and label its dimensions.
 - The home will need to have at least 3 bedrooms, 2 baths, a kitchen, and garage.
4. Find the square footage of each room and the total square footage of the home
5. Justify your design with mathematical and economic arguments.

See Notes and reference sources on the next page

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Links:

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2. Wikipedia, the free Encyclopedia
 - a. Sphere - http://en.wikipedia.org/wiki/Sphere#Volume_of_a_sphere
 - b. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - c. Dome - http://en.wikipedia.org/wiki/Sphere_packing
 - d. Monolithic dome - http://en.wikipedia.org/wiki/Sphere_packing
 - e. List of celebrated domes - http://en.wikipedia.org/wiki/Sphere_packing

California State Standards for Mathematical Reasoning

Students make decisions about how to approach problems:

Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing and prioritizing information, and observing patterns.

Formulate and justify mathematical conjectures based on a general description of the mathematical question or problem posed.

Determine when and how to break a problem into simpler parts.

Students use strategies, skills, and concepts in finding solutions:

Use estimation to verify the reasonableness of calculated results.

Apply strategies and results from simpler problems to more complex problems.

Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work.

Make precise calculations and check the validity of the results from the context of the problem.

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Real World Globes – Spherical Math Manipulative™ Spherical Activity # Four – Global Navigation Concepts & Principles®

Purpose:

- To study global navigation concepts and principles.
- Introduce principles of spherical geometry



Supplies:

1. A **Real World Globe™**
2. Atlas
3. Spherical Protractor

Tasks

1. Your task will be to find the latitude & longitude of the locations that Sir Francis Drake visited during his circumnavigation of the earth.
 - Note! The globe will have the path of Drake's Journey

Latitude Longitude

- (_____, _____) Plymouth, England
(_____, _____) Essaouira Mogador
(_____, _____) Cape Blanco
(_____, _____) Mayo, Cape Verde Islands
(_____, _____) St. Tiago
(_____, _____) Rio Grande, Brazil
(_____, _____) Cape Santa Maria
(_____, _____) White Bay
(_____, _____) Port St. Julian
(_____, _____) Strait of Magellan
(_____, _____) Bay of Severing Friends
(_____, _____) Mocha Island
(_____, _____) Valpraiso
(_____, _____) Santiago
(_____, _____) Coquimbo
(_____, _____) Tarapaca
(_____, _____) Lima
(_____, _____) South of Panama
(_____, _____) Guatulco
(_____, _____) Cano Island



- (_____, _____) Nova Albion
(_____, _____) Caroline Islands
(_____, _____) Ternate Island
(_____, _____) Celebes
(_____, _____) Java
(_____, _____) Cape of Good Hope
(_____, _____) Sierra Leone
(_____, _____) Plymouth, England

Links:

1. Real World Globes – <http://www.realworldglobes.com>
2. Wikipedia, the free Encyclopedia
 - a. Latitude - <http://en.wikipedia.org/wiki/Latitude>
 - b. Longitude - <http://en.wikipedia.org/wiki/Longitude>
 - c. Francis Drake - http://en.wikipedia.org/wiki/Francis_Drake
 - d. Sphere - http://en.wikipedia.org/wiki/Sphere#Volume_of_a_sphere
 - e. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - f. Navigation - <http://en.wikipedia.org/wiki/Navigation>

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California State Standards for Mathematical Reasoning & Algebra

Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Understand and use coordinate graphs to plot simple figures, determine lengths and areas related to them, and determine their image under translations and reflections.

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Real World Globes – Spherical Math Manipulative™

Spherical Activity # Five – Great Circles®

Supplies:

1. A **Real World Globe™**
2. Atlas
3. Spherical Protractor



Activity:

When you label two points on a plane, you determine one distinct line. On a sphere, when you label two points, you determine one distinct great circle, unless the two points are opposite points. (These points are sometimes called antipodes.) The famous ones are the North and South Poles.

1. Label two points A and B on your globe.
(Do not make them opposite points.)
2. Draw the largest circle that goes through these two points.
(This is called the great circle.)
 - A. Find the measurement of the minor arc connecting A & B.
 - B. Find the measurement of the major arc connecting A & B.
 - C. Find the length of the minor arc connecting A & B.
 - D. Find the length of the major arc connecting A & B.
3. Draw the smallest circle that goes through these two points.
 - A. Find the measurement of the semicircle connecting A & B.
 - B. Find the length of the semicircle connecting A & B.
4. Draw a third circle that goes through these two points.
 - A. Find the measurement of the minor arc connecting A & B.
 - B. Find the measurement of the major arc connecting A & B.
 - C. Find the length of the minor arc connecting A & B.
 - D. Find the length of the major arc connecting A & B.

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 - b. Longitude - <http://en.wikipedia.org/wiki/Longitude>
 - c. Sphere - http://en.wikipedia.org/wiki/Sphere#Volume_of_a_sphere
 - d. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - e. Great-circle - http://en.wikipedia.org/wiki/Great_circle
 - f. Spherical geometry – http://en.wikipedia.org/wiki/Spherical_geometry

California State Standards for Mathematical Reasoning & Algebra

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Geometry (7th Grade through 12th)

Draw, construct and describe geometrical figures and describe the relationships between them.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Understand and apply theorems about circles.

Visualize relationships between two-dimensional and three-dimensional objects.

Apply geometric concepts in modeling situations.

Find arc lengths.

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Real World Globes – Spherical Math Manipulative™

Spherical Activity Number Six - Angles®



Supplies:

1. A **Real World Globe™**
2. Compass
3. Spherical Protractor
4. Spherical Ruler

Activity:

When you extend the rays of an angle on a flat surface they never come back. On a sphere when you extend the rays of an angle they return to the vertex.

1. Label a point A on the equator of your globe.
With your spherical protractor draw a 15 degree angle from the equator.
With the spherical ruler, extend the ray of your angle so it comes back to point A, creating a great circle.
The great circle you have drawn should intersect with the equator on the opposite side of the globe. Label this point B. (These points are opposite poles or antipodes.)
Measure the angle formed by the great circle and equator at point B.
(The measurement should be the same!)
2. With your spherical protractor draw a 30 degree angle from point A and the equator.
With the spherical ruler, extend the ray of your angle so it comes back to point A, creating another great circle.
The great circle you have drawn should intersect with the equator on the opposite side at point B again.
Again, measure the angle formed by the great circle and equator at point B.
(The measurement should be 30 degrees!)
3. With your spherical protractor draw several more angles from point A and the equator.
With the spherical ruler, extend the ray of your angle so it comes back to point A,
All of these great circles that you are creating should be intersecting at point B and have the same measure.
4. If you have not done so already, draw a 90 degree angle from point A and the equator.
(You have created a latitudinal line that goes through the North and South Poles besides through point B.)

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 - b. Longitude - <http://en.wikipedia.org/wiki/Longitude>
 - c. Sphere - http://en.wikipedia.org/wiki/Sphere#Volume_of_a_sphere
 - d. Spherical wedge - http://en.wikipedia.org/wiki/Spherical_wedge
 - e. Great-circle - http://en.wikipedia.org/wiki/Great_circle
 - f. Spherical geometry – http://en.wikipedia.org/wiki/Spherical_geometry

California State Standards for Mathematical Reasoning & Algebra

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Geometry (7th Grade through 12th)

Draw, construct and describe geometrical figures and describe the relationships between them.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Understand and apply theorems about circles.

Visualize relationships between two-dimensional and three-dimensional objects.

Apply geometric concepts in modeling situations.

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Real World Globes – Spherical Math Manipulative™

Spherical Activity # Seven – Latitude, Longitude & Antipodes®

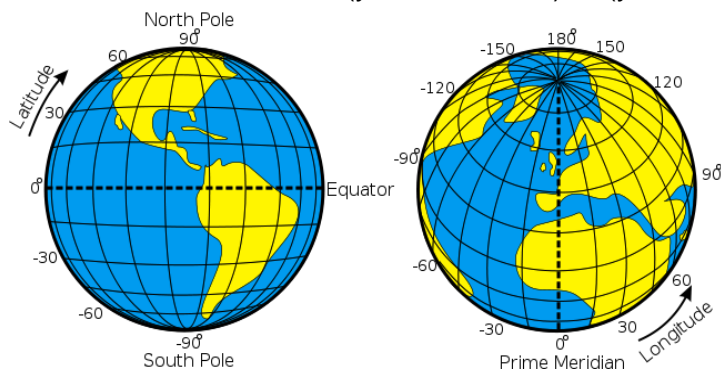
Supplies:

1. A **Real World Globe™**
2. Dry Erase Marker
3. Spherical Protractor
4. Spherical Ruler



Antipodal Points

In mathematics, antipodal points are two points on the opposite ends of a circle or sphere. The line drawn from one point to the other must pass through the center of the sphere or circle creating the diameter. The mathematical description (latitude and longitude) of a point on the Earth's surface are (ϕ, θ) , then the coordinates of the antipodal point are $(-\phi, \theta \pm 180^\circ)$. In geographical terms, the transformation would be $(y^\circ \text{ N/S}, x^\circ \text{ E/W})$ to $(y^\circ \text{ S/N}, [180-x]^\circ \text{ W/E})$.



Activity:

1. Find the latitude and longitude, in geographical terms, of the antipodal cities below:

1. Palembang (Indonesia) $3^\circ\text{S } 105^\circ\text{E}$ -----Nelva (Colombia) _____
2. Padang (Indonesia) $1^\circ\text{S } 101^\circ\text{E}$ -----Esmeraldas (Ecuador) _____
3. Valdivia (Chile) $40^\circ\text{S } 73^\circ \text{W}$ -----Wuhai (China) _____
4. Christchurch (New Zealand) $44^\circ\text{S } 172^\circ\text{E}$ -----A Coruña (Spain) _____
5. Hamilton (New Zealand) $38^\circ\text{S } 175^\circ\text{E}$ -----Córdoba (Spain) _____
6. Tauranga (New Zealand) $38^\circ\text{S } 176^\circ\text{E}$ -----Jaén (Spain) _____
7. Whangarei (New Zealand) $36^\circ\text{S } 174^\circ\text{E}$ -----Tangier (Morocco) _____
8. Ulan Ude (Russia) $52^\circ\text{N } 107^\circ\text{E}$ -----Puerto Natales (Chile) _____
9. Perth (Australia) $32^\circ\text{S } 116^\circ\text{E}$ -----Hamilton (Bermuda) _____
10. Barranquilla (Colombia) $11^\circ\text{N } 75^\circ\text{W}$ ----Christmas Island (Australia) _____



2. Translate the cities' latitude and longitude values into a mathematical coordinate description.

- | | |
|-------------------------------------|------------------------------------|
| 1. Palembang (Indonesia) _____ | Nelva (Colombia) _____ |
| 2. Padang (Indonesia) _____ | Esmeraldas (Ecuador) _____ |
| 3. Valdivia (Chile) _____ | Wuhai (China) _____ |
| 4. Christchurch (New Zealand) _____ | A Curuña (Spain) _____ |
| 5. Hamilton (New Zealand) _____ | Córdoba (Spain) _____ |
| 6. Tauranga (New Zealand) _____ | Jaén (Spain) _____ |
| 7. Whangarei (New Zealand) _____ | Tangier (Morocco) _____ |
| 8. Ulan Ude (Russia) _____ | Puerto Natales (Chile) _____ |
| 9. Perth (Australia) _____ | Hamilton (Bermuda) _____ |
| 10. Barranquilla (Colombia) _____ | Christmas Island (Australia) _____ |

3. Lastly plot and label the cities on the Real World Globe.

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2. Wikipedia, the free Encyclopedia
 - a. Latitude - <http://en.wikipedia.org/wiki/Latitude>
 - b. Longitude - <http://en.wikipedia.org/wiki/Longitude>
 - c. Sphere - http://en.wikipedia.org/wiki/Sphere#Volume_of_a_sphere
 - d. Spherical geometry – http://en.wikipedia.org/wiki/Spherical_geometry
 - e. Antipodal point – http://en.wikipedia.org/wiki/Antipodal_point



California State Standards for Mathematical Reasoning & Algebra

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Geometry (7th Grade through 12th)

Draw, construct and describe geometrical figures and describe the relationships between them.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Understand and apply theorems about circles.

Visualize relationships between two-dimensional and three-dimensional objects.

Apply geometric concepts in modeling situations.

(Students will develop an understanding of latitude, longitude & antipodes.)

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Real World Globes – Spherical Math Manipulative™

Spherical Activity #8 – Determining Distance and Position ©



Supplies:

1. A **Real World Globe™**
2. Dry Erase Marker
3. Spherical Protractor
4. Spherical Ruler

Determining a distance

The nautical mile (symbol M, NM or nmi) is a unit of length that is about one minute of arc of latitude along any meridian, but is approximately one minute of arc of longitude only at the equator. 1 nautical mile = 1.852 km = 1,852 m = 1.15078 mi = 6,076 ft

A nautical mile is based on the circumference of the planet Earth. If you were to cut the Earth in half at the equator, you could pick up one of the halves and look at the equator as a circle. You could divide that circle into 360 degrees. You could then divide a degree into 60 minutes. A minute of arc on the planet Earth is 1 nautical mile. This unit of measurement is used by all nations for air and sea travel.

The great-circle distance or orthodromic distance is the shortest distance between any two points on the surface of a sphere measured along a path on the surface of the sphere (as opposed to going through the sphere's interior).

Determining a position

A **bearing** is basically the angle with respect to north from point A measured in the direction of point B. In land navigation, a **bearing** is ordinarily calculated in a clockwise direction starting from a reference direction of 0° and increasing to almost 360 degrees. In a contemporary land navigation context, **true**, **magnetic**, and **grid bearings** are always measured in this way, with **true north**, **magnetic north**, or **grid north** being 0° in a 360° system.



True north-based bearings (azimuths)

From North			
North	0° or 360°	South	180°
North-Northeast	22.5°	South-Southwest	202.5°
Northeast	45°	Southwest	225°
East-Northeast	67.5°	West-Southwest	247.5°
East	90°	West	270°
East-Southeast	112.5°	West-Northwest	292.5°
Southeast	135°	Northwest	315°
South-Southeast	157.5°	North-Northwest	337.5°

Activity:

1. Plot and label the following cities on the Real World Globe.

1. Los Angeles, California 34° N / 118° W
2. New York, New York 41° N / 74° W
3. London, England 52° N / 0° W
4. Moscow Russia 56° N / 38° E
5. Johannesburg, South Africa 26° S / 28° E
6. Beijing, China 40° N / 116° E
7. Honolulu, Hawaii 21° N / 158° W
8. Sydney, Australia 34° S / 151° E
9. Buenos Aires, Argentina 35° S / 58° W
10. Montreal, Canada 46° N / 74° W
11. Anchorage, Alaska 61° N / 150° W



2. Plot the shortest distance between the following cities on the Real World Globe. Determine what that distance and bearing would be between each city.

1. Los Angeles, California & New York, New York _____, _____
2. New York, New York & London, England _____, _____
3. London, England & Moscow Russia _____, _____
4. Moscow Russia & Johannesburg, South Africa _____, _____
5. Johannesburg, South Africa & Beijing, China _____, _____
6. Beijing, China & Honolulu, Hawaii _____, _____
7. Honolulu, Hawaii & Sydney, Australia _____, _____
8. Sydney, Australia & Buenos Aires, Argentina _____, _____
9. Buenos Aires, Argentina & Montreal, Canada _____, _____
10. Montreal, Canada & Anchorage, Alaska _____, _____
11. Anchorage, Alaska & Los Angeles, California _____, _____

Helpful Links:

1. Real World Globes – <http://www.realworldglobes.com>
2. Wikipedia, the free Encyclopedia
 - a. Latitude - <http://en.wikipedia.org/wiki/Latitude>
 - b. Longitude - <http://en.wikipedia.org/wiki/Longitude>
 - c. Great circle - http://en.wikipedia.org/wiki/Great_circle
 - d. Bearing - [http://en.wikipedia.org/wiki/Bearing_\(navigation\)](http://en.wikipedia.org/wiki/Bearing_(navigation))

Activity created by CHARLES DICHIERA
For: www.realworldglobes.com



California State Standards for Mathematical Reasoning & Algebra

Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Geometry (7th Grade through 12th)

Draw, construct and describe geometrical figures and describe the relationships between them.

Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Understand and apply theorems about circles.

Visualize relationships between two-dimensional and three-dimensional objects.

Apply geometric concepts in modeling situations.

Please contact **Real World Globes** with questions or input at: www.info@realWorldGlobes.com

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Earth Science Standards and Curricula addressed by using the Real World Globe™

This whitepaper summarizes standards specified in the National guidelines for ‘inquiry-based education’ for science education in primary and secondary schools in the U.S. These Standards stress the importance of using many different approaches to teaching science. Just as inquiry has many different facets, so teachers need to use many different strategies to develop the understandings and abilities described in the Standards. Students need to have opportunities to develop their understanding of science by combining scientific knowledge with reasoning and thinking skills. The tactile and manipulative nature of the Real World Globe supports and reinforces the learning process by combining real world data and information with lessons that promote critical thinking.

Each state has slightly different curriculum standards to address the National guidelines. As an example of what can be achieved in any given curriculum using the Real World Globes we have chosen California’s “Science Content Standards for California Public Schools, Kindergarten through Grade Twelve” as an example. Below we outline the many topics within a given science curriculum that can be addressed using the Real World Globe in the classroom.

California has adopted a plan for academically rigorous content standards in science. This agreement on standards is a great first step in making sure that all students are leaving school with the same knowledge and skills to be competitive in a global market, but everyone agrees that while these guidelines are helpful, the actual mechanisms for teaching are many and varied. The use of manipulatives in teaching has been shown to help students make the leap from intuitive to logical thinking, and to promote the ability to think in the abstract. While some science learning is dependent on knowing specific facts or information, some of the most important learning that takes place in a science curriculum are context-dependent critical thinking skills and processes.



Grade 5 Earth Sciences

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:

- a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
- b. Students know when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.
- c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.
- d. Students know that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.
- e. Students know the origin of the water used by their local communities.

4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:

- a. Students know uneven heating of Earth causes air movements (convection currents).
- b. Students know the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
- c. Students know the causes and effects of different types of severe weather.

Grade 6

Focus on Earth Sciences: Plate Tectonics and Earth's Structure

1. Plate tectonics accounts for important features of Earth's surface and major geologic events. As a basis for understanding this concept:

- a. Students know evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.
- c. Students know lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
- d. Students know that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.
- e. Students know major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
- f. Students know how to explain major features of California geology (including mountains, faults, volcanoes) in terms of plate tectonics.
- g. Students know how to determine the epicenter of an earthquake and know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region.



Shaping Earth's Surface

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:

- a. Students know water running downhill is the dominant process in shaping the landscape, including California's landscape.
- b. Students know rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
- c. Students know beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.
- d. Students know earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

Grade 7

Earth and Life History

4. Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:

- a. Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
- b. Students know the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.
- f. Students know how movements of Earth's continental and oceanic plates through time, with associated changes in climate and geographic connections, have affected the past and present distribution of organisms.

High School

Dynamic Earth Processes

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:

- a. Students know features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.
- b. Students know the principal structures that form at the three different kinds of plate boundaries.
- c. Students know how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.
- d. Students know why and how earthquakes occur and the scales used to measure their intensity and magnitude.
- e. Students know there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes.
- f. Students know the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction.



Energy in the Earth System

4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:

- a. Students know the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.

5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:

- a. Students know how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
- b. Students know the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
- c. Students know the origin and effects of temperature inversions.
- d. Students know properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
- e. Students know rain forests and deserts on Earth are distributed in bands at specific latitudes.
- f. Students know the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.
- g. Students know features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.

6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:

- a. Students know weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.
- b. Students know the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.
- c. Students know how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.